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MADE IN INDIA: CISCO REROUTES INNOVATION

Very few multinationals have succeeded in building leading edge products end to end from India.

Dr Ishwar Parulkar, Distinguished Engineer, Cisco Systems (India)

With these words, Ishwar Parulkar, Distinguished Engineer at the networking major Cisco Systems (India) Limited, began the tale of a product, the Advanced Services Router 901[1] ('ASR 901') router. Parulkar had joined Cisco in 2009, as a senior technologist to lead architecture for a product development effort for emerging markets.[2] This was part of a larger strategy by Cisco headquarters to understand what could be built *in* the developing markets *for* the developing markets, as opposed to products conceived with only developed markets as the focus. Within a time frame of a few months, a team formed from scratch, developed the ASR 901, the next generation, global networking technology product that was developed completely – from conception to launch – at the Bangalore site in India.

The ASR 901 successfully took on the challenge of delivering all the functionalities and features required by sophisticated telecoms clients, while meeting the specific requirements of its customers from the developing markets. It not only went on to win the 'New Technology Advancement NASSCOM 2012 Innovation' award and the Economic Times Award for the Most Innovative Telecom Infrastructure product in 2012, but orders began streaming in from not just the developing economies (as had been expected) – but also from the tier-1 customers in the developed markets.

ASR 901 was undoubtedly a milestone in Cisco India's indigenous innovation initiatives. Parulkar reflected upon the many challenges that had been faced during the process, and the actions that had been taken to achieve success during this process. Could the lessons learnt while progressing through the several stages of developing this product be applied to similar new initiatives? Were the factors that contributed to the success of the ASR 901 generic enough to be applied as a template for innovation and product development from India?

Cisco[3]

Cisco, a global leader in networking, was founded in December 1984 by a small group of computer scientists from Stanford University. Since its founding, Cisco has recorded intense growth. By the end of the fiscal year 2012, Cisco had employed over 66,000 employees working across the globe,

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[1] ASR 901 was a next generation 3G/LTE capable mobile backhaul and carrier Ethernet platform. It was a router that was deployed at a cellular tower site or business premise to backhaul voice and data traffic into the core of the network.
[2] Ishwar Parulkar was previously employed by Apple and Sun Microsystems in the US.
[3] Cisco Systems, March 31, 2012 Form 10-Q (filed September 12, 2012), http://investor.cisco.com/secfiling.cfm?filingID=1193125-12-388590, accessed October 2012.

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with net sales of US$46.1 billion and net income of US$8.0 billion (refer to **Exhibit 1** for further details on the financial performance). Cisco was in the business of designing, manufacturing, and selling Internet Protocol ("IP") based networking and other products related to the communications and information technology industry; and providing services associated with these products and their use. The company provided a broad range of products around the world for transporting data, voice, and video within buildings and across campuses. Its vision was "to transform how people connect, communicate, and collaborate".

In fiscal 2012, Cisco completed its grouping of products and technologies into the following categories: Switching, Next-Generation Network ("NGN") Routing, Collaboration, Service Provider Video, Wireless, Security, Data Center, and Other Products. In an additional endeavour to support the fast-growing emerging countries, the company also re-organized its business into the following three geographic segments: the Americas; Europe, Middle East, and Africa ("EMEA"); and Asia Pacific, Japan, and China (refer to **Exhibit 2** for further details on the net revenue across geographies).

Cisco's presence in India

Cisco India commenced operations in 1995, with a handful of engineers. With the booming Indian IT industry, Cisco India experienced a gradual shift from largely services engineering driven by labour arbitrage, to innovation and original product development locally – both for the local and global markets.[4] A real boost to Cisco's presence in India happened in 2006, when Wim Elfrink, Cisco's chief globalization officer moved from the US to Bangalore. This coincided with a very conscious effort by Cisco headquarters to invest in India, as they wanted Cisco to be the first truly global company. Elfrink elaborated on the strategic factors that led to creating the Cisco Bangalore campus:

> *Cisco realised that we are at an inflection point. GDP growth in emerging countries is higher than the GDP growth in Europe or the US. Number two, almost everything is green fields. There is no install base. And so you will see a lot of new business models emerging here in the east. And then thirdly, the US and Europe are getting older. China's already aging. This part of the world, and specifically India, is getting younger. The next coming twenty years, India will have an inflow of undergraduates of more than 600 thousand a year. And so the growths, the innovation, the talent made us drive to go closer.*

> Wim Elfrink, EVP Cisco Services and Chief Globalisation Officer Cisco[5]

Elfrink brought along with him a cadre of key US staff. By then, Bangalore had already boasted a significant team of engineers. He proceeded to set up Cisco's Global Development Center, which was the largest such centre outside of the US.

Cisco, as a networking company, dealt with building the infrastructure and technologies for the internet and enterprise networks. At the top level, in terms of organisation, the primary technology groups were service provider technology group, enterprise networking technology group, data

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[4] Ishwar Parulkar, "Innovation and Product Development from Emerging Countries: A case study on Cisco's ASR 901 product", April 10, 2012 accessed August 2012.

[5] Podcast Transcript for Cisco Globalization, Part 1, with Wim Elfrink, EVP Cisco Services and Chief Globalization Officer, Cisco, aired on October 29, 2007,
http://www.cisco.com/warp/public/146/news_cisco/Newsroom/podcasts/transcript/Transcript_Wim_Elfrink_Globalisation.pdf?Referring_site=Globalization2007PressKit&Event=CG2007&Position=Podcast2Transcript, accessed October 2012.

centre group, video collaboration group and a few others. The organisation structure in India reflected this organisation, with all groups represented by different levels of expertise and engineering ownership. Most business units in the headquarters had engineering Directors located in Bangalore, with the chain of command, product conception/architecture and P&L responsibility with executives in HQ. The Service Provider Technology group (SPTG) had the largest presence with close to half of the engineers of the group based in India.

Cisco India worked on a go-to-market strategy through its over 2,500 partners, of which 11 Gold Certified Partners included top companies such as Bharti Airtel Services Ltd, IBM, Wipro and TCS. By 2012, Cisco India included over 8,000 employees. With sales and marketing operations spread across key cities in India, it was the recognized market leader in the networking market in core technologies of routing and switching (refer to **Exhibit 3** for further details on the market share). The company also developed technologies for unified communications, data centres, security, video, virtualization and cloud computing.

Another advantage that Cisco India was perceived to have was that all the different business units were physically co-located in the same site, which was expected to make collaboration across businesses far easier. There, thus, soon came about a real thrust for innovating in India.

Cisco India –Quest for innovation

By 2009, the Cisco centre in the Bangalore campus was well established. Highly qualified and experienced management leaders had been either relocated to India or grown through the ranks, and by 2009 there were approximately 10 VP/SVP and 80 Directors. However, Cisco headquarters continued to come back with some hard questions: how important was it to run innovation out of Bangalore? What's the return on investment? Isn't centralized research and development more effective and efficient?[6] But momentum was building up in Bangalore, and the team there was asking itself whether they could really build a product from scratch at the Bangalore site.

As the focus of the site shifted to innovation and product development, there was also a push to bring in highly qualified and experienced senior technologists. This enabled the creation of a small core leadership group with the skill sets and experience to conceptualise and build the next generation technology product, such as the ASR 901, from this site.

ASR 901: Cisco India develops an innovative, next generation technology product

Cisco's Visual Networking Index (VNI) Forecast (2011-2016) suggested that there would be about 10 billion network connections, and the global mobile internet traffic would increase 18 fold by 2016. The ASR 901 was conceptualised as an advanced services cell site router, where operators can see reduction of their backhaul operating costs, simplify and converge their Radio Access and Ethernet Access Networks. It was a mobile backhaul platform used to build the next generation 3G/LTE networks, while allowing for a gradual transition from 2G networks to these next generation networks (refer to **Exhibit 4** for a visual representation of this product) and support the dramatic growth in mobile internet traffic (refer to **Exhibit 5** for further details on the global router market).

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[6] Dr Ishwar Parulkar in conversation with the authors on August 13, 2012

Parulkar elucidated on the genesis of how the ASR 901 came to be the first end-to-end product that was built from the Cisco India site:

> It came about because of two inflection points that happened at Cisco India. One of them was the explosion of mobile devices subscribers in places like India and China, and so we saw an opportunity to build something in this space and capitalize on that market. Secondly, from a Cisco India site perspective, we had evolved to a point where we were doing many complex engineering projects and there was a very keen interest from the site to take this to the next level, which was conceiving and building an end-to-end product from here. We defined a product that would enable the service providers to build their next generation of mobile networks. The ASR 901 was sufficiently complex to be a proving point for this capability from India, but could be done in a span of about 2 years as opposed to a longer product development cycle, which would have tested the patience of the company in terms of a new site developing an end-to-end product.

The ASR 901 development team functioned very much as a start-up. And like many start-ups, it was constrained by resources. One of the approaches taken was to partner with a local service engineering company. While the relationship was not unusual in that technology companies often did partner for scoping and engineering of large projects, this partnership went further: Cisco offered the partner a share in the revenue. This had the added advantage of the partner putting more "skin in the game", which in turn was beneficial in developing a strong local ecosystem that went beyond the typical engineering tasks that were very much the bread and butter of outsourced operations.

One of the key challenges faced in building a complex system such as the ASR 901 was the lack of a mature, local eco-system in India. This product required several key pieces of technology, such as silicon chips, compliance testing and other interconnected parts. But some of these parts of the ecosystem were not mature enough in the country. The team in India had to thus work very closely with teams based in the US, which was a challenge because some tasks – such as debugging systems in the lab – needed close interaction with technology partners. This resulted in frequent late night calls or shipping key experts across continents, which often took much longer than it would if they were just across the street, as was the case in places such as the Silicon Valley. But over the course of the project, the ecosystem was developed. The team got into partnerships co-developing some pieces of the technology locally with partners. This also gave the partners a reason to build up their local sites. Cisco US had a long standing relationship with partners in the US and these were leveraged by convincing them that this was not a one-off case, and Cisco India was truly committed to building more of such products. Consequently, these partners started building their own sites in India as well. The team also transferred some of Cisco's knowledge and expertise in areas like testing for global telecom compliance standards to labs in India.

The project progressed through three phases: incubation phase, prototype phase and mainstream development.

1. Incubation phase

This phase lasted for about four months, where a small core group comprising senior product management lead and a senior architect, jumpstarted the product definition. This small core group was funded by the Globalization Office and a senior executive from HQ – the then head of SPTG – who were supporters of developing the site. The small core start-up team met with customers to understand the key issues they faced in emerging markets and their network infrastructure strategy.

This strategy was elaborated by Mahesh Raghava, Director, Product Development and one of the original group members:

> We first reached out to customers across emerging markets. Because we realised that once we developed products for these countries with compact form factor, low power, ability to withstand extreme temps and low cost – this would be popular globally too. The first point of information had been our own field teams, who mentioned that there was a huge growth in mobile telephony in the emerging markets. With that information, we talked to our customers in China, Africa, Brazil, India - and tried to understand all their requirements. We asked them about the areas they were working on, their requirements and the pain points. Based on the responses and factoring Cisco's knowledge and vision of where networking was headed, we defined a family of platforms that became the ASR 901. We incorporated next generation features, while keeping specific needs of emerging countries in mind such as low CPAEX/OPEX for customers, protecting their investment in existing 2G infrastructure, the need to scale rapidly, harsh environmental conditions, etc. However, at no stage did we scale down on performance or advanced features to meet the requirements of emerging countries.

2. Prototype phase

The next phase involved quickly developing a prototype to demonstrate the capability and feasibility of developing a product like this. This phase happened in a sandbox[7] environment over six months or so, whereby a small team including engineers from the service partner developed a hardware prototype running basic software. This milestone enabled the team to gain further funding from headquarters, so that the development could enter a more mainstream effort by hiring a full team and building more prototypes for full product testing and qualification.

The basic prototyping could be done by the small start-up team, but to become a product with the Cisco label, it was necessary to engage other central organisations in the company such as the operating system group, the network management group, the central compliance testing and corporate compliance group. As the project gradually moved from the prototype phase to mainstream development phase, the team worked on gaining buy-in and commitment of the central organisations, which was essential to releasing it as a product.

3. Mainstream development

Along with the prototype providing the team credibility, the traction in the field and interest from customers worked in favour of moving to a more mainstream development model. The customer accounts and sales teams from all geographies heard about the development and got interested as the product fit the needs of several of the customers they were talking to. Dr. Partho Mishra, VP/GM, Service Provider Group, Cisco Systems (India), who headed the business unit that launched the ASR 901 summarised:

> Market validation is key, and at Cisco, particularly, it is a big thing. If something has wings, the first feedback that we get is interest from the sales teams.

This phase took about 6-8 months, and included about 60-70 engineers, excluding support from other functional engineering organisations from within the company. By bringing it to the mainstream, the team also benefitted from filling up crucial engineering resource gaps and getting

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[7] A sandbox was a testing environment that isolated untested code changes and experimentation from the production environment.

support from some of Cisco's key central functions, such as the operating system group compliance certification – all essential as a lead up to the actual commercial launch of the product.

The way these three phases played out were critical in the success of the development of the product. As Parulkar stated, "If we did not go through incubation and prototype development in a sand-box, we would not have been able to get an effort like this off the ground, and if we had not entered a more mainstream process towards the end, we would not have been able to launch a Cisco-certified product and it would have remained a prototype in the lab."

This process and structure too was atypical for Cisco India. The team had remained involved all the way up to the launch of the product in late 2011 – approximately 18 months from start to finish.

ASR 901: Success at Reverse Innovation

Mishra commented:

> *Our initial customers came from the US and developed markets. This happened not because the product was not relevant for India, but because it was complex and sophisticated enough at a price point that made it attractive for service providers in the US and other developed markets.*

ASR 901 was not a cut-down product. On the contrary, the challenge was to deliver all the functionalities and features required by sophisticated telecoms customers (3G-4G deployment, advanced synchronization, fibre optics, etcetera) while responding to the specific requirements of the customers in emerging markets. Hence, it was cutting edge technology, but at a much lower price. It was meant for 3G and 4G networks, yet allowed a path for operators with large, existing 2G networks to seamlessly and gradually evolve to 3G/4G, while protecting their 2G investment. This meant that it could work in almost any telecom environment. The ability to deploy once and enable extra features and capacity over time allowed local telecoms companies to scale rapidly, without incurring all the cost upfront. This was critical in cost-sensitive, developing markets with rapidly growing telecom needs. Power consumption turned out to be another key unique selling proposition. The product was extremely power efficient, consuming approximately half of what similar products from other vendors consume. Parulkar commented on the product's uniqueness, "ASR 901 was innovative not only from a product definition perspective, but also from a networking technology and hardware/software development perspective".

Building an innovation culture

Parulkar added:

> *One of the real challenges was finding technical talent to do this kind of product and then building a culture of innovation and a product development mindset. We did a combination of things to meet this challenge. First, as everybody in Cisco India was very supportive because this was going to be a key proving point for the site, they were more than willing to lend engineers with expertise in certain areas for short periods of time for specific pieces of the code and such. Also, we hired very talented, very motivated people even if they didn't have the experience we were looking for. We looked for people who had the learning capability and the passion, and then we did a few intense focus workshops with experts in the company to train the engineers rapidly. The other thing was we had a very flat organisation. All the engineers, right from the most experienced senior architect to the most junior engineer, worked closely with constant interactions in shared workspaces. The engineers saw first-hand, how product trade-*

offs and decisions were made. Risk taking and innovative thinking was encouraged through the ranks. Another advantage was that the team was small, so we didn't have to deal with a deep hierarchy, where we would have had to go through levels of decision-making and deal with lack of transparency. The team was also very passionate about the project, as was the leadership.

One of the key skill sets that was initially missing in Cisco India was the senior technologists and architects who conceptualised products, came up with new technologies, and synthesised all of that into building products that would ultimately be beneficial to society. One reason for this was the cultural context in India, where very often, engineers would prefer to go up the managerial path, and hence the industry lost out on engineering talents. However, while developing the ASR 901, the Cisco India engineers began to understand the leadership role a technologist played in this kind of product development.

The change in pursuing the innovation culture was clearly a strong thrust area for Cisco India's leadership. As Menon commented, "What we are doing here in the globalization centre in Bangalore now is to think beyond the product. We do have our engineers who are developing the products/technologies and the innovations around that - but we are also asking what are the applications and solutions that we might be developing for the globe, from India. We always use the expression for India, from India, but this is not about creating products just for India".[8]

By 2012, the company had put in place a number of tools to encourage and systematically expand the innovation culture across the site. One example was the annual *Innovation Sparks* competition, where all Cisco engineers were encouraged to submit their ideas, not necessarily related to their job at hand, but relevant to Cisco. A jury of senior technologists evaluated the ideas and the best ones were selected for further development and given visibility. In addition, several formal training programs had been developed to immerse engineers with leadership potential in activities that would accelerate their learning and growth as technical leaders. Frequent events were held that enabled engineering teams to demonstrate prototypes of the innovative work they were doing to the wider site and executives.

What does ASR 901's success imply?

The ASR901 was launched in late 2011, and had been doing very well. In a public recognition of what it had achieved, the product won the 'New Technology Advancement NASSCOM 2012 Innovation' award and The 2012 Economic Times Award for the Most Innovative Telecom Infrastructure Product. Customers from all over the world, including North America and Europe, had lined up in terms of booking. Cisco India continued to work on variants of the product, to meet capacity for different segments of the network and incorporate evolving telecom standards. It was also improving some other features in mobile backhaul, such as resiliency and timing accuracy. In the long term, the development team was looking at extending this backhaul technology into 'small cells', an emerging technology that would address the spectrum scarcity and resulting capacity challenge in the coming years.

The ASR 901 was proof for developing complex, next generation technology products from India. It was also an example of how emerging countries' requirements could be factored into global products. Parulkar and his team were contemplating whether the lessons learned from the ASR 901

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[8] Dr Anil Menon, President Globalisation and Smart Connected Communities, Cisco Systems (India) in conversation with the authors on August 12, 2012

experience could be distilled into creating a generic template for successful innovation at Cisco India? What did the company's leadership need to do to nurture the culture of innovation that it had embarked on at the India site?

**EXHIBIT 1: CISCO'S FINANCIAL PERFORMANCE FOR FISCAL YEARS 2010-2012
(IN US$ MILLIONS)**

	YTD ending July 28, 2012	YTD ending July 30, 2011	YTD ending July 31, 2010
Net Sales	46,061	43,218	40,040
Cost of sales	(17,852)	(16,682)	(14,397)
Gross Margins	28,209	26,536	25,643
Operating Expenses	(18,144)	(18,862)	(16,479)
Operating Income	10,065	7,764	9,164
Net Interest and other income	94	151	251
Profit before tax	10,159	7,825	9,415
Provision for Income Tax	(2,118)	(1,335)	(1,648)
Net income	8,041	6,490	7,767

**Source: Cisco Systems, Annual Financial Statements, April 24, 2013,
http://investor.cisco.com/financialStatements.cfm, accessed April 2013.**

EXHIBIT 2: CISCO'S NET SALES ALONG GEOGRAPHIES FOR FISCAL YEAR ENDING JULY 28, 2012 (IN US$ MILLIONS)

	Fiscal year ending July 28, 2012	**Fiscal year ending July 30, 2011**	**Increase YOY (%)**
Net sales:			
Americas	**26,501**	25,015	5.9%
Percentage of net sales	*57.5%*	*57.9%*	
Europe, Middle East & Africa	**12,075**	11,604	4.1%
Percentage of net sales	*26.2%*	*26.8%*	
Asia-Pacific, Japan, China	**7,485**	6,599	13.4%
Percentage of net sales	*16.3%*	*15.3%*	
Total	**46,061**	43,218	6.6%

**Source: Cisco Systems, March 31, 2012 Form 10-Q (filed September 12, 2012),
http://investor.cisco.com/secfiling.cfm?filingID=1193125-12-388590, accessed October 2012.**

EXHIBIT 3: CISCO INDIA'S MARKET SHARE ACROSS KEY PRODUCT LINES

Core Technologies

Router: 72.6%

Switch: 64.1%

Total LAN: 67.3%

Source: CY Q1'12, IDC LAN Tracker, June 2012

Advanced Technologies

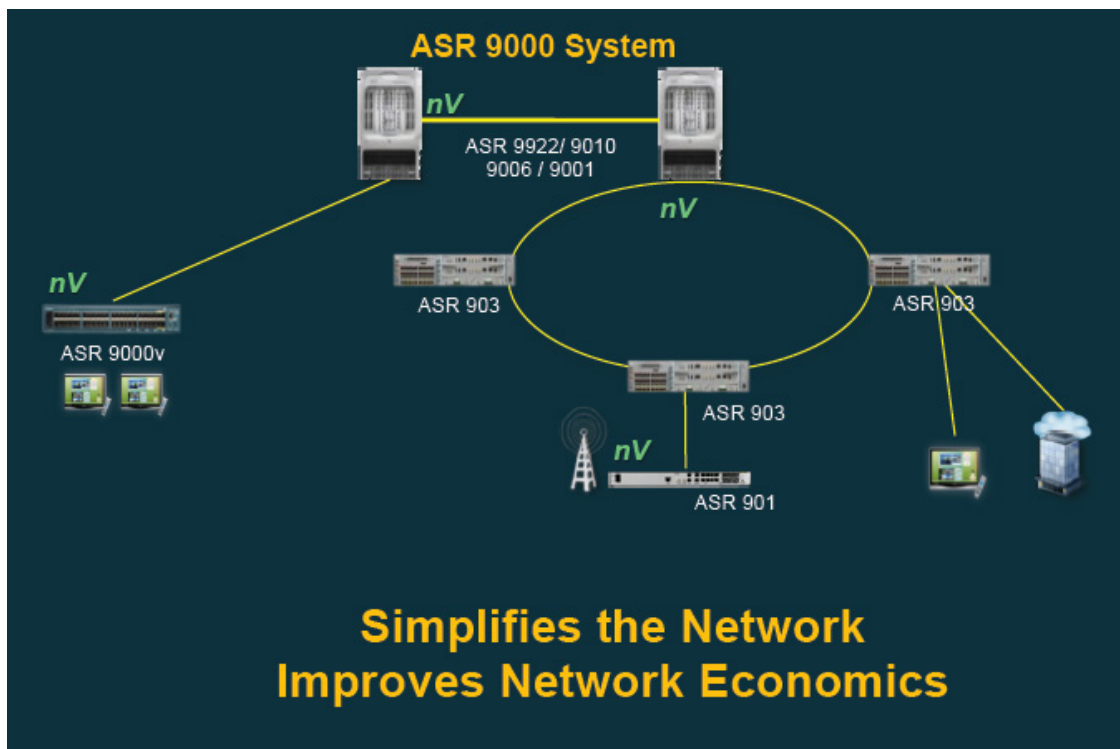WLAN: 40.0% (CY Q1'12, IDC, June 2012)

Security: 34.9% (CY Q1'12, Frost & Sullivan, June 2012)

Enterprise Telephony: 35.5% (CY Q1'12, Frost & Sullivan, June 2012)

IP PBX: 55.6% (CY Q1'12, Frost & Sullivan, June 2012)

Source: Cisco India Overview, http://www.cisco.com/web/IN/about/company_overview.html, accessed October 2012.

EXHIBIT 4: THE ASR 901 SERIES AGGREGATION SERVICES ROUTERS AND THEIR DEPLOYMENT

Source: Sanjeev Mervana and Ray Mota, Cisco presentation, Competing on TCO: Superiority of the Cisco Solution, May 6, 2012, Cisco Knowledge Network http://www.ciscoknowledgenetwork.com/files/231_6-5-12_CKN_Master_Deck_v3d_Final.pdf?utm_source=&utm_medium=&utm_campaign=&PRIORITY_CODE, accessed April 2013.

EXHIBIT 5: THE GLOBAL CARRIER ROUTER AND SWITCH MARKET

Infonetics Research reported that 2012 ended with global IP edge and core router and carrier Ethernet switch revenue rising to $3.8 billion, up 12% from the previous quarter. The report stated:

"In 2012, sales of core routers slowed more than edge routers, as the coming move to 100G is making carriers increasingly cautious as they choose the next generation of higher-capacity core routers. The top four manufacturers in the router and carrier Ethernet switch segment stayed in dominant positions in 2012, with Cisco in the top place, and Huawei at the second spot, holding steady, while Alcatel-Lucent moved into the third spot, bumping Juniper to the fourth place.

In the race for router-only market share, Cisco maintained the top position in 2012, but Huawei and Alcatel-Lucent boosted their revenue market share following big gains in 4Q12. Overall, the global carrier router and switch market ended 2012 with a small 4% loss, but it could have been worse but for significant budget flushes from operators in Europe, China and Latin America that buoyed the overall market in the final quarter of the year.

It was also expected that the service provider switch and router market would grow again in 2013. The US economy was in better shape and in EMEA, activity looked good for the Middle East and, to some degree, Africa, and Europe appeared to have hit bottom. A slow climb could be expected for the IP router and switch market there, albeit from this lower starting point. Operators know they need to spend on their networks or risk becoming uncompetitive."

TOP SERVICE PROVIDER ROUTER AND SWITCH VENDORS BY 2012 GLOBAL REVENUE SHARE
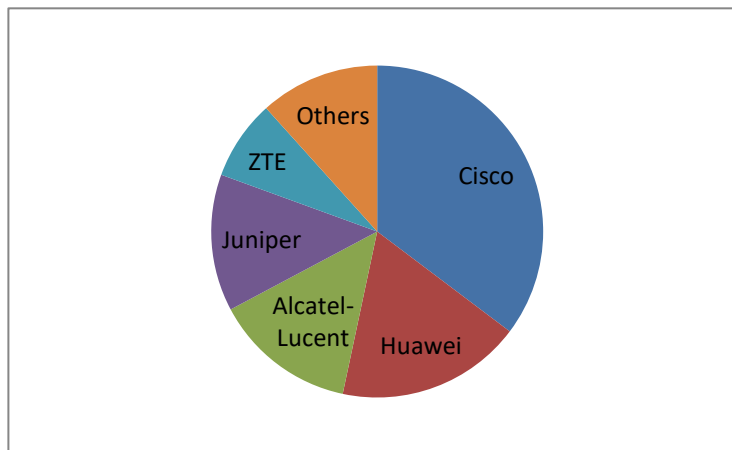
Data adapted from Infonetics Research, Service Provider Routers and Switches, Quarterly Market Share, Size and Forecasts, February 2013.

Source: Infonetics Research, "Infonetics Predicts Resurgence in 2013 for Carrier Router and Switch Market", February 25, 2013, downloaded from SMU Library, http://ehis.ebscohost.com/eds/detail?vid, accessed April 25, 2013. Also: http://viodi.com/2013/02/23/infonetics-optimism-on-service-provider-routerswitch-market-contrasts-with-ciscos-cautious-outlook/ accessed on April 25, 2013.